

The benefit-risk ratio of wearing face masks during the Covid-19 pandemic

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Abstract

In December 2019, the world has seen the appearance of a new respiratory virus that belongs to the Coronavirus family called SARS Cov2. This virus is highly contagious and at that point, there was no treatment or vaccine available against it.

The medical staff resorted to the use of personal protective equipment such as face masks to protect against Covid-19.

Soon, the use of facemasks became mandatory for individuals in many countries around the world and it is no longer restricted to medical personnel only.

However, in the light of the use of facemasks, which seems to be necessary, several questions arise concerning the benefits and risks associated with wearing these masks.

This review aims to clarify the protective role of facemasks against the spread of Sars-cov-2 and to focus on the risks that may pose to humans.

Our study shows that wearing protective masks is beneficial to protect against the spread of covid-19 in two ways, directly by limiting the diffusion of aerosols, and indirectly by reducing the face touching.

On the other hand, wearing face masks for long periods of time can affect the cardiopulmonary activity, lead to skin problems, such as (itching, rashes, burns, acne), or ocular problems, and headache, not to mention the impact on interpersonal communication by affecting the perception of voices on one side and the perception of faces and emotions on the other side.

In order to benefit from the advantages of masks while avoiding the risks that may be associated with their use, the general population must be educated on the proper way to wear these medical devices.

Keywords: Benefit, COVID-19, Effect, Masks, Risk.

Introduction

Covid 19 is a respiratory virus that belongs to the Coronavirus family, it first appeared in December 2019

in Wuhan city in China, and it quickly spread throughout the country, and then throughout the world. On March 11, 2020, the World Health Organization declared COVID-19 as a global pandemic.

As for the other respiratory viruses, the transmission of SARS-CoV-2 is mainly conducted by the respiratory route through droplets.(1)(2)

Several countries in the world have adopted preventive measures to try to limit the spread of this highly contagious virus (2), namely the wearing of facemasks, which has become mandatory in many countries in the world.

The purpose of this study is to review the benefits of wearing facemasks against Covid-19, and to shed light on the negative effects that may occur to humans, In order to ensure the correct use of these devices and to minimize the risks that may arise from them.

Benefits of wearing face masks against covid-19

A facemask is a device designed to protect the user from inhaling harmful dust, pathogens, fumes, vapors, or gases. Masks and respirators are the most important piece of personal protective equipment against Covid-19.(3)

Several studies have addressed the subject of the benefits of wearing facemasks for protection against SARS Cov2.

Bouchnita et al. used multiscale mathematical models of COVID-19 transmission dynamics to simulate and quantify the effects of movement restriction and facemask wearing on disease spread in the Moroccan population. (4)

The predictions obtained indicate that the adoption of the restriction measures alone decreased the number of new cases from 86.4% to 42.4%, the mandatory wearing of facemasks decreased this figure to 30.8%. The number

of deaths decreased from 4% to 3.2% under restriction alone and to 2.4% after wearing protective masks. (4)

Cheng et al. compared the incidence of COVID-19 per million population in Hong Kong, where mask wearing is generalized (96.6% of the population wear masks), with the incidence in selected countries that are identical to Hong Kong in terms of population density, health care system, BCG (tuberculosis) vaccination, and social distancing measures, but where face masks were not generally adopted by the population during the first 100 days of virus onset (December 31, 2019, to April 8, 2020). (5)

The incidence of COVID-19 in Hong Kong (129.0 per million population) was significantly lower ($p < 0.001$) than in Spain (2983.2), Italy (2250.8), Germany (1241.5), France (1151.6), the United States (1102.8), the United Kingdom (831.5), Singapore (259.8), and South Korea (200.5). (5)

For asymptomatic individuals, the incidence of COVID-19 was studied in 197 residents in Taizhou city, Zhejiang province in China who had direct contact with 41 pre-symptomatic patients returning from Wuhan.(6)

Hong et al. found that the incidence was significantly higher in residents not wearing masks compared to those wearing protective masks (19.0% vs. 8.1%, $p < 0.001$). (6)

To analyze the effect of facemasks on the spread of COVID-19 in Germany, Mitze et al. adopted the synthetic control method: an identification approach that exploits regional variation in the timing of mandatory facemask use on public transport and stores. Depending on the region studied, wearing facemasks reduced the number of newly recorded COVID-19 infections by 15-75% over 20 days after their mandatory introduction. After assessing the credibility of the various estimates, it

was concluded that facemasks reduced the daily growth rate of reported infections by approximately 47%. (7)

In contrast, Bundgaard et al's paper demonstrated that recommending the use of surgical masks outside home (as an adjunct to other public health measures) did not reduce the rate of SARS-CoV-2 infection by more than 50%, among those who wore them in a community with modest rates of infection, some degree of social distancing, and low mask use. (8)

On the same view, Steven et al., found that there was no reduction in daily population mortality, hospital bed occupancy, intensive care bed occupancy, or ventilator occupancy of COVID-19-positive patients, after implementation of mask mandate, through a comparative analysis conducted at Texas' state in USA, between the period of June 2 to July 2 and the post-masking period of July 8, 2020, to August 12, 2020. (9)

This may reveal that wearing masks may be optional compared to other measures such as social distancing. Hence, the interest in studies comparing the effects of different preventive measures against Covid-19.

However, protection against the Covid-19 virus by facemasks can also be obtained indirectly by reducing the face touching.

Chen et al's study showed that: face touching behaviours (eyes, nose, mouth) decreased during the period of Covid-19 (when mask-wearing was generalized) compared with the period of pre-Covid-19, among individuals in China (72 incidences of 1745 observations [4.1%] to 12 incidences of 1097 observations [1.1%]; $P < 0.001$), South Korea (80 incidences of 717 observations [11.2%] versus 7 incidences of 324 observations [2.2%]; $P < 0.001$), and Europe (62 incidences of 546 observations [11.4%] versus 23 incidences of 379 observations [6.1%]; $P = 0.01$). (10)

Similarly, Shiraly et al's work conducted in Iran, generated evidence that face masks can decrease face touching in the general population by noting that non-mask wearers touched their faces significantly more often than mask wearers (11 vs. 8 times per hour, $P < 0.001$). Those not wearing masks were 1.5 times more likely to touch their mucous membranes than those wearing masks ($P < 0.001$). (11)

The work of Liebst et al conducted in AMSTERDAM and ROTTERDAM (12) confirms this hypothesis (12). Nevertheless, Guellish et al's research on the French population revealed that of the 143 (79%) people who wore a surgical mask, 87 (48%) of them touched their mask an average of 15 times per hour, of which only two (8%) used a hydroalcoholic solution to disinfect their hands (13).

These results affirm the need to teach the public about the correct way to wear facemasks to try to reduce the touching of the face.

However, the studies carried out in this context remain limited and research guidelines in this sense are recommended.

Risks associated with wearing protective masks

Cardiopulmonary activity

82% of the subjects examined in the study completed by Marinova et al reported breathlessness when using the masks (14).

The parameters of pulmonary and cardiac function studied in the work of Fikenzer et al. (ventilation, cardiopulmonary exercise capacity, and comfort) are also reduced by the use of surgical masks and strongly altered by FFP2/N95 masks in healthy individuals. (15)

The results of Pifarré et al. also concluded that mask use by athletes results in hypoxic and hypercapnic breathing, reflecting the increased effort during exercise. (16)

A study accomplished by Purushothaman PK et al., suggests that the use of N95 face masks and surgical masks for a period exceeding 4 hours induces exertional breathing difficulties in healthcare workers (58.2%). (17)

However, the results of Shaw et al. demonstrated that wearing a face mask did not affect arterial oxygen saturation, tissue oxygenation index, perceived exertion rating, or heart rate at any time during exercise testing. Wearing a face mask during vigorous exercise has no discernible negative effect on blood or muscle oxygenation or exercise performance in young, healthy participants. (18)

Wearing protective masks may present some changes in cardiopulmonary parameters with some differences in the results obtained by each study, which can be explained by the physiological differences of the patients as well as whether the mask was worn during the performance of the physical activity or not and depending on the intensity of this activity. Nevertheless, these changes are minor and do not pose a high risk to the overall cardiopulmonary activity of healthy individuals.

Cautious assessment of cardiopulmonary parameters should be taken in subjects with lung disease before attempting physical activity with a mask.

Skin problems

It has been shown that wearing protective masks can cause skin reactions for the wearer, the most common of those reactions, according to Techasatian et al. , acne (39.9%), facial rashes (18.4%), and itching (15.6%). Wearing a surgical mask had a higher risk of adverse skin reactions than wearing a cloth mask. Wearing a mask for more than 4 hours per day and reusing masks increased the risk of these reactions compared to changing the mask daily. (19)

Purushothaman PK et al. also carried out a study which showed that wearing a face mask for a period longer than 4 hours by healthcare workers caused adverse skin reactions such as acne (56.0%), itchy nose (52.0%). (17) Elisheva et al. reported that prolonged use of N95 masks and surgical masks by health care workers during the COVID-19 pandemic resulted in adverse skin reactions such as rash and acne. (20)

The results of the study conducted by Scarano et al. suggest that N95 respirator masks are able to induce an increase in facial skin temperature, greater discomfort, and less adherence to wearing compared to medical surgical masks, which may explain the cause of these skin manifestations. (21)

59.7% of the subjects included in the Marinova et al.'s study suffered from skin problems such as itching, rashes, burns, acne, dermatitis, intertrigo, impetigo, miliaria, etc. (14)

The use of N95 masks is associated with more skin side effects than the use of surgical masks according to Naqvi and coll. (22)

The N95 masks are among the most effective masks against Covid-19, they have a filtration capacity and an adaptation with the face better than those of the surgical mask, which will generate an increase in the temperature of the face which explains the appearance of the cutaneous demonstrations by the part of this type of mask.

Headaches

The results of the study conducted by Elisheva et al. indicate that headaches are the most reported problem by face mask users in 71.4% of cases (20)

Hajjij et al. investigated 155 health care workers in Morocco, (95.5%) of them used N95 masks, associated with eye protection in (61.3%) of cases. The overall

prevalence of headaches related to this personal protective equipment was 62%. (23)

Ramirez-Moreno et al. performed their study in 306 healthcare workers, (79.7%) of them were using surgical masks and 53 (20.3%) filter masks. Of all the individuals in this study, 158 (51.6%) had recent onset headache. The occurrence of headache was independently associated with the use of filter masks and is more frequent in some healthcare workers, resulting in a greater occupational, family, personal and social impact.(24)

10.4% of the subjects examined in the study carried out by Marinova et al complained of a headache at the end of the day (14).

The common occurrence of headache in protective mask wearers, especially in healthcare workers, can be explained by the hypoxia and hypercapnia that can be caused by wearing masks, especially during exertion and for prolonged periods.

Ocular problems

The use of facemasks can cause various eye problems. 70.1% of the subjects included in the Marinova et al study reported the appearance of ocular symptoms including burning, redness, tearing, foreign body sensation, itching, blurred vision, dry eye sensation and undefined ocular discomfort. (14)

There was also noted, according to Silkiss et al in San Francisco and Los Angeles, a significant increase in the incidence of chalazion between June and August 2020 compared with the same duration in 2018 and 2019. It has been suggested that widespread mask wearing coincides with this increase which may be due to mask-induced dry eye and changes in the eyelid microbiome(25)

The study conducted by Krolo et al. confirmed the existence of mask-associated dry eye (MADE), more

profoundly in women, subjects with a history of DED, and if wearing a face mask for over 3 hours per day. Ophthalmologists should inform their patients of the potential ocular surface health risks associated with poorly fitting face masks. (26)

However, Boccardo et al's study found that of the 2447 participants with ocular symptoms, 658 (26.9%) reported that these symptoms were exacerbated by wearing a mask, representing 18.3% of all participants. There was no significant association between perceived mask-associated dry eye and age, refractive correction, and pre-existing ocular discomfort, whereas a positive association was observed with female gender and retail work. (27)

Because face masks are necessary to slow the spread of COVID-19, it is important not to underestimate any symptoms that might discourage people from using them. Eye care professionals should check all patients complaining of mask-induced eye discomfort or symptoms for clinical signs and suggest methods to alleviate this condition.

Communication

Voice perception

Despite its crucial protective role, the face mask poses challenges on everyday interpersonal communication that describes the interaction between two or more individuals through speech or gestures.

Ribeiro et al. found that wearing face masks can have negative effects on self-perceived voice: Face masks increase the perception of vocal effort, difficulty understanding speech, and difficulty coordinating speech and breathing, especially in individuals who wore face masks for work activities. (28)

The results of the Corey et al. study suggest that all masks attenuate frequencies above 1 kHz, that attenuation is greatest in front of the speaker, and that

there is considerable variation between mask types, including cloth masks with different materials and fabrics. Transparent masks have poor acoustic performance compared to medical masks and cloth masks. (29)

Data presented in the study by Magee et al. show that face masks alter the speech signal, but specific acoustic characteristics are not affected (e.g., voice quality measures) regardless of mask type. (30)

The variance in voice quality results between different authors may be primarily due to differences in the types of masks worn and the materials used in the design of these masks.

Facial and emotional perception

Wearing masks resulted a qualitative change in the way masked faces are perceived which may have significant effects on daily activities and social interactions according to Freud et al.(31)

Lower accuracy and confidence in the assessment of displayed emotions indicate that emotion reading is strongly irritated by the presence of a mask.

Carbon et al. also detected specific confounding patterns in the reading of certain emotions, primarily in the misinterpretation of disgust being angry and the evaluation of many other emotions (e.g., joy, sadness, and anger) as neutral.(32)

According to Shack et al, the extensive use of face masks during the COVID-19 pandemic presents a challenge for pediatric clinicians who rely on facial expression to engage with patients and overcome fear or apprehension. The only study that addressed this issue found that half of children aged 4-10 years preferred to be cared for by physicians wearing face shields rather than surgical masks; some were afraid of masked physicians.(33)

Although the work addressing the topic of the effect of wearing protective masks on interpersonal communication is relatively limited, it has all demonstrated that these masks represent a barrier to effective communication. In fact, research guidelines in this sense are strongly recommended.

Conclusion

Covid-19 is a virus of the Coronavirus family characterized by a very high contagion and morbidity.

During the current pandemic of SARS-CoV-2, the wearing of protective masks defined as a non-pharmacological intervention to limit the spread of this virus has become a simple and mandatory gesture for the general population.

The benefits of this measure are indisputable, notably for the control of infection in individuals, medical personnel and populations, whether directly by reducing the emission of aerosols, or indirectly by reducing contact with the face. In addition, the masks also offer protection against the inhalation of micro-plastics and against ultraviolet radiation.

However, the wearing of protective masks for long periods (more than 4 hours) can cause some undesirable problems: skin (acne), cardiopulmonary (breathing difficulties), eye (burning, redness, watering ...), pain, headaches or even psychological problems such as anxiety that may be due to neglecting the type of mask to wear or the way it should be worn.

Communication in the Covid-19 area has also been affected by the wearing of protective masks, affecting the perception of the voice, faces and emotions of the masked people.

There are many articles dealing with the benefits and risks of protective masks. However, the benefit/risk ratio of masks for individuals and general populations has yet

to be clarified, although the published results are promising.

Given the data cited above, the current results highlight the need for further research not only to try to decrease the side effects of wearing protective masks but also to increase their life span.

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Table 1: Various studies about benefits of wearing face masks against COVID-19.

Authors	Populations	Interventions	comparisons	Outcomes	Study design
Bouchnita et al. (4)	Moroccan population	Simulation of the impact of restricting population movement and requiring masks (all types of masks combined) on the spread of COVID-19 by a simulation model.	None	Decrease in the number of new cases registered by 11.6% and in the number of deaths by 0.8%.	Multi-scale modeling (simulation study)
Cheng et al. (5)	Covid cases - positive at HSKAR, China	Calculation of covid-19 incidence in HSKAR, China where masks are mandatory (all types of masks combined)	Covid-19 incidence in Spain, France, Italy, Germany, USA, UK, Singapore, South Korea where masks are not mandatory	The incidence of COVID-19 in Hong Kong with generalized mask use is significantly lower compared to other countries with no generalized mask use by the population ((129.0 per million	Epidemiological analysis

				population compared to (2983.2) (2250.8), ...)	
Hong et al. (6)	127 Covid-19 positive patients	Epidemiological trajectory and clinical characteristics of Covid-19 cases were retrieved from electronic medical records and an individual questionnaire to assess the effect of mask wearing (all types of masks combined) on the spread of Covid-19.	None	The incidence of COVID-19 was significantly higher in asymptomatic subjects not wearing masks compared to those wearing protective masks (19.0% vs. 8.1%, p<0.001)	Retrospective epidemiological analysis
Mitze et al. (7)	German population	Calculation of new covid-19 positive cases at the time when face masks became mandatory	The period when face masks are not mandatory	- Reduction in the number of newly registered COVID-19 infections by 15-75%. - Reduction in the daily growth rate of reported infections by approximately 47%.	synthetic control method
Bundgaard et al. (8)	3030 participants (Adults spending more than 3 hours per day outside home without occupational	Encouragement to follow social distancing measures, plus mask recommendation to wear surgical mask outside the home	Encouragement to follow social distancing measures plus no mask recommendation.	Infection with SARS-CoV-2 occurred in 42 participants recommended masks (1.8%) and 53 control participants	A randomized controlled trial

	mask use.)			(2.1%).	
Steven G et al. (9)	Bexar, Texas, United States	To study the values of daily population mortality, hospital bed occupancy, ICU bed occupancy, and ventilator occupancy of COVID-19-positive patients after the implementation of a mask mandate in Bexar, Texas, USA between the period of July 8, 2020, to August 12, 2020	The period from June 2 to July 2 (mask not mandatory)	No reduction in daily population mortality, hospital bed occupancy, ICU bed occupancy, or ventilator occupancy of COVID-19-positive patients after implementation of a mask mandate	Observational epidemiology (Comparative analysis)
Chen et al. (10)	4699 individuals before the COVID-19 pandemic and 2887 individuals during the pandemic	analyze mask-wearing and face-touching behavior in public areas through videos recorded in public transportation stations, streets, and parks among the general population in China, Japan, South Korea, Western Europe (i.e., England, France, Germany, Spain, and Italy), and the US	Pre-pandemic period.	Wearing a facemask reduces contact with the face, nose, mouth, and eyes.	cross-sectional study
Shiraly et al. (11)	1000 Iranian people	Calculation of the average number of touches to the mucosal zone per hour in mask wearers	Not using mask	Individuals not wearing masks touched their faces significantly more often than those wearing masks (11 versus 8 times per hour, $P < 0.001$).	Observation of individuals for 15-30 minutes in public places between April 22 and May 9, 2020.

Liebst et al. (12)	- Study 1: 383 people - Study 2: 421 people	Study 1: an analysis of public face touching behaviors among people in Amsterdam in the Netherlands through public safety camera data taken during the COVID-19 pandemic, between May and early June 2020. Data recording during 5 days. Study 2: The study is performed in 6 areas in Amsterdam and Rotterdam, mask wearing is mandatory in 3 of them. Data recording during 13 days between the end of July and the end of August 2020.	None	Wearing facemasks does not increase face touching (face and T-zone: i.e., eyes, nose, and mouth). Study 1: 12% (21/176) of masked and 13% (27/207) of non-masked individuals touched their face or mask. Study 2: 23% (38/167) of masked individuals and 18% (46/254) of non-masked individuals touched their face or mask.	Observational epidemiological study
Guellish et al. (13)	182 people	The study of the frequency of mask touching behavior in Paris' metro in France between May 4 and 25, 2020.	None	(48%) of mask wearers touched their mask an average of 15 times per hour, of which only two (8%) used a hydroalcoholic solution.	Observational study

Table 2: Various studies about risks of wearing face masks

Auteurs	Populations	Interventions	Comparaisons	Outcomes	Study design
Marinov	144 people	Evaluation of ocular	Absent	59.7% reported skin	Pilot study

<p>a et al. (14)</p>	<p>(medical staff and others)</p>	<p>problems caused by the use of protective masks by means of a questionnaire + complete ophthalmological examination</p>		<p>irritations, 82% shortness of breathe with the mask, 10.4%) complained of a headache at the end of the day. The skin problems included itching, rash, burning, acne, dermatitis, intertrigo, impetigo... Additional complaints included pain in the zones of contact with a mask, sweating, irritated and painful skin of the ears blurring of eyeglasses problems with their position, etc. 70.1% reported ocular symptoms, including burning, redness, tearing, foreign body sensation, itching, blurred vision, dry eye feeling, and undefined eye discomfort</p>	
<p>Fikenzer et al. (15)</p>	<p>12 healthy people</p>	<p>Evaluation of cardiopulmonary function parameters when wearing masks (surgical, FFP2 or N95)</p>	<p>No mask</p>	<p>Ventilation, cardiopulmonary exercise capacity and comfort are reduced by surgical masks and highly impaired by FFP2/N95 face masks in healthy individuals.</p>	<p>Prospective cross- over study</p>

Pifarré et al. (16)	8 people (6 men and 2 women)	Evaluation of the physiological impact of hypercapnia hypoxia generated by masks during aerobic sports practice through measurements of HR (heart rate), O ₂ and CO ₂ concentration and SatO ₂ with masks.	No mask	The use of masks by athletes causes hypoxic and hypercapnic breathing as evidenced by increased effort during exercise. The use of masks during a short exercise with an intensity around 6--8 METS, decreases O ₂ by 3.7% and increases the CO ₂ concentration by 20%.	Evaluation of eight subjects at baseline with and without a mask, and immediately after a 21-flex test performed following the Ruffier protocol with a mask.
Purushothaman et al. (17)	250 Health care personnel	Evaluation of the effects of prolonged wear (more than 4 hours) of face masks by a questionnaire	Absent	Excessive sweating around the mouth accounting to 67.6%, difficulty in breathing on exertion 58.2%, acne 56.0% and itchy nose 52.0%.	Cross-sectional study
Shaw et al. (18)	14 participants (7 men and 7 women)	Evaluation of the effects of wearing a surgical mask, a cloth mask, during a cycle ergometry test to exhaustion. Arterial oxygen saturation (pulse oximetry) and tissue oxygenation index (indicator of hemoglobin saturation/desaturation) at vastus lateralis were assessed	No mask	Wearing a face mask during vigorous exercise had no discernable detrimental effect on blood or muscle oxygenation, and exercise performance in young, healthy participants	A randomized, counterbalanced cross-over design

		throughout the exercise tests			
Techasatian et al. (19)	833 (Health care workers and others)	Exploring the prevalence of the facemask related adverse skin reactions during the ongoing COVID-19 after a recommendation of facemask wearing for public use in Thailand.	Absent	The prevalence of face mask related adverse skin reactions was (54.5%), of which acne was the most frequent (39.9%), followed by rashes on the face (18.4%), and itch symptoms (15.6%). Wearing a surgical mask showed a higher risk of adverse skin reaction compared to a cloth mask, A duration of face mask wearing of more than 4 hours/day and the reuse of face masks increased the risk of adverse skin reactions compared to changing the mask every day	A prospective cross-sectional study
Elishева et al. (20)	343 healthcare professionals	Study of the adverse effects of facemasks on healthcare workers located in New York City who worked at the hospital during the COVID-19 pandemic. Through a questionnaire	Absent	314 respondents reported adverse effects from prolonged mask use with headaches being the most common complaint (n = 245). 175 respondents experienced skin breakdown, and acne	cross sectional study

		composed of 21 questions		was reported in 182 respondents. Impaired cognition was reported in 81 respondents.	
Scarano et al. (21)	20 subjects.	Study of the facial skin temperature and the heat flow when wearing medical surgical masks for 1 hour.	Wearing N95 respirators.	N95 respirators are able to induce an increased facial skin temperature, greater discomfort and lower wearing adherence when compared to the medical surgical masks.	20 subjects were recruited and during the evaluation, each subject was invited to wear a surgical mask or respirator for 1 h. The next day, the same subject wore a N95 mask for 1 h with the same protocol. Infrared thermal evaluation was performed.
Naqvi et al. (22)	300 healthcare professionals	Comparison of the incidence of cutaneous hazards caused by surgical mask in health care providers during covid-19 pandemic and response of topical methylprednisolone aceponate (MPA) to associated contact dermatitis	Wearing N95	Use of N95 masks are associated with more cutaneous side effects as compared to use of surgical masks.	*Total 300 participant who use surgical masks or N95 for more than 10 days during duty hours were interviewed in order to fill a pre-designed preform a regarding cutaneous impact of using mask versus N95 masks.
Hajjij et al. (23)	155 healthcare workers	Evaluation of the onset or aggravation of headaches associated with the	Absent	(95.5%) of the healthcare professionals used N95 masks, combined	Cross-sectional study

		use of personal protective equipment in Morocco through a questionnaire.		with eye protection in 61.3% of cases. The overall prevalence of headaches related to this personal protective equipment was 62%.	
Ramirez -Moreno et al(24)	306 healthcare workers	Analyze the association between the appearances of headache on health professionals through an online questionnaire in Spain.	None	Of all the people interviewed in this study, 158 (51.6%) had recent onset headache. The occurrence of headache was independently associated with the use of filter masks compared to surgical masks	Cross-sectional study
Silkiss et al. (25)	Patients of two ophthalmology institutions	Calculation of the incidence of chalazion recorded in patients consulting between January and August 2020 (pandemic) in Los Angeles and San Francisco	Data recorded during the same period in 2017, 2018 and 2019	In San Francisco, the incidence of chalazion rose significantly in June through August of 2020 when compared to the same interval in 2016, 2017, 2018, and 2019. In Los Angeles, the rise in chalazion incidence in 2020 was also statistically significant when compared to data from the years 2018 and 2019	retrospective multicenter study
Krolo et	203 participants	Determining if	None	-Group that used	A prospective

al. (26)	(all using surgical face-masks daily)	wearing a face mask during COVID-19 pandemic causes a new onset or deterioration of previously existing dry eye disease through a survey, containing modified Ocular Surface Disease Index (OSDI) questionnaire		masks from 3 to 6 hours/day demonstrated significantly higher OSDI scores compared to < 3 hour/day group -Participants with prior DED exhibited greater worsening of their disturbances during mask wearing period compared to the ones without previous DED	cohort study
Boccardo et al. (27)	3,605 surveys	Distribution of an anonymous online survey, using Google Forms through different social media platforms to measure self-reported symptoms of mask-associated dry eye in the general population and to identify factors influencing this condition.	None	Of the 2,447 having symptoms, (26.9 %) of participants reported their symptoms were exacerbated when wearing a mask, thus 18.3 % of all participants experienced mask-associated dry eye.	observational, descriptive, and cross-sectional study
Ribeiro et al. (28)	468 people	Evaluation of the effects of wearing protective masks (N95; cloth masks, disposable masks ...) on voice perception parameters in individuals who wore facemasks for	People who wore face masks only for essential activities	Facemasks increased the perception of vocal effort, difficulty in speech intelligibility, auditory feedback, and difficulty in coordinating speech and breathing, irrespective of usage.	an observational, descriptive, cross-sectional study

		occupational and essential activities during the Covid-19 pandemic.		Individuals who wore facemasks for professional and essential activities had a greater perception of symptoms of vocal fatigue and discomfort, vocal effort, difficulties in speech intelligibility, and in coordinating speech and breathing.	
M. Corey et al. (29)	Absent	Examination of the acoustic attenuation caused by different face masks, including medical, cloth, and transparent masks, using a head-shaped loudspeaker and a live human talker	Absent	All masks attenuate frequencies above 1 kHz, the attenuation is greatest in front of the talker, and there is substantial variation between mask types, especially cloth masks with different materials and weaves. Transparent masks have poor acoustic performance compared to both medical and cloth masks.	To simulate sound heard by a conversation partner, a side-address cardioid condenser microphone was placed two meters from the talker position. To study the effect of masks on sound reinforcement and assistive listening systems, omnidirectional lavalier condenser microphones were placed next to the mouth, on the lapel, on the cheek, and the forehead of the talker.

<p>Magee et al. (30)</p>	<p>7 subjects</p>	<p>Measuring the acoustic parameters of timing, frequency, disturbance and power spectral density Examination of speech intelligibility, word, and sentence using the Assessment of Intelligibility of Dysarthric Speech.</p>	<p>Absent</p>	<p>Mask type affected the power distribution in frequencies above 3 kHz for the N95 mask, and above 5 kHz in surgical and cloth masks. Measures of timing and spectral tilt mainly differed with N95 mask use. Cepstral and harmonics to noise ratios remained unchanged across mask type. No differences were observed across conditions for word or sentence intelligibility measures; however, accuracy of word and sentence translations were affected by all masks</p>	<p>Overall, seven subjects (aged 28.1 6 6.0 years, range 21–39; four males, three females), were included in the study. All speakers were English speaking with no dysphonia-cognitive, or neurological impairments. One male (15 years since exposed to English) and female (26 years since exposed to English) were subsequent bilinguals and reported English as their second language. A.</p>
<p>Freud et al.(31)</p>	<p>293 people</p>	<p>Evaluation of face processing abilities for masked and unmasked faces in a large online sample of adult observers using an adapted version of the Cambridge Face Memory Test, a validated measure of</p>	<p>Unmasked faces</p>	<p>Masked faces showed a substantial decrease in performance. Importantly, the inclusion of masks also led to a qualitative change in the perception of the masked faces. Similar changes were found whether masks</p>	<p>participants were recruited online during the period of May–June 2020</p>

		face perception abilities in humans.		were included during the study or the test phases of the experiment.	
Carbon et al. (32)	41 people	Participants assessed the emotional expressions displayed by 12 different faces. Each face was randomly presented with six different expressions (angry, disgusted, fearful, happy, neutral, and sad) while being fully visible or partly covered by a facemask.	Unmasked faces	Lower accuracy and lower confidence in one's own assessment of the displayed emotions indicate that the presence of a mask irritated strongly emotional reading. We further detected specific confusion patterns, mostly pronounced in the case of misinterpreting disgusted faces as being angry plus assessing many other emotions (e.g., happy, sad, and angry) as neutral.	participants (N = 41, calculated by an a priori power test; random sample; healthy persons of different ages,